

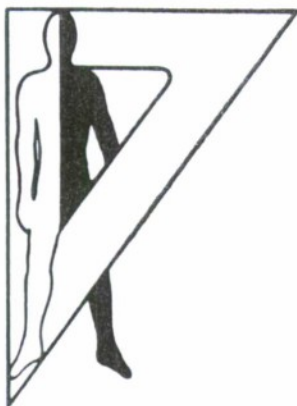
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Technical Note 3-76

U. S. ARMY HUMAN ENGINEERING LABORATORY
MOBILITY/PORTABILITY COURSE TRAINING PROGRAM

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Marcia Morgan

August 1976

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U. S. ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland

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U. S. ARMY HUMAN ENGINEERING LABORATORY
MOBILITY/PORTABILITY COURSE TRAINING PROGRAM

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Personal Equipment and Life Support Systems Team
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August 1976

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INTRODUCTION

In evaluating and improving equipment of any kind, the ultimate test is how well that equipment performs in the hands of its intended user. The Armed Services is vitally interested in this type of systems evaluation for its combat troops. However, since testing under actual fighting conditions is impractical, the need arises for determination of face validity through testing of military items under simulated military conditions. These conditions might include marching over various types of terrain or maneuvering through a carefully designed obstacle course. The activity involved is often physically demanding and requires a certain level of physical conditioning on the part of the troops.

Additionally, in experimental situations where humans are involved as subjects (Ss) and there is more than one trial, the possibility always exists that physical conditioning or learning might mask treatment effects. In order to reduce that problem as much as possible and to provide adequate physical preparation for test situations, a physical training program has been established for use with troops prior to actual testing.

OBJECTIVES

The objectives of this report are (a) to provide a simple, reliable, valid procedure for evaluating the physical condition of troops to be used in systems evaluations; and (b) to recommend an abbreviated training program for those troops prior to testing, based on their condition.

METHOD

In recent years there has been considerable research published regarding what constitutes physical fitness and how it can best be evaluated. An analysis of the available literature provides the basis for selection of appropriate measures to be used which fulfill the needs of this report, i.e. that they be simple to administer to groups of Ss and be reliable and valid. Then, based on the same principles used to condition and train athletes, an abbreviated conditioning program was designed for a general preparation for any type of physical testing.

PRELIMINARY CONSIDERATIONS

Based on available literature in exercise physiology, two alternative measures of aerobic capacity were selected which provide an indication of an individual's overall fitness. Both tests are self paced and adaptable for use in various climates. Since the major difference in the two tests is that one is performed within a set time frame over a variable distance and the other is run over a set distance with the time being variable, it is up to the tester to select which is more suitable for his purposes.

A second aspect of physical condition, power, was also considered to be of major importance; therefore, two power tests were incorporated into the overall picture.

Another factor to be taken into consideration when designing a conditioning program or training schedule is what type of activity the Ss will be tested on. Based on an evaluation of that activity, it can be determined what energy system is utilized in that activity. Then the conditioning program is set up so that the appropriate energy system can be more specifically developed for improved performance.

Aerobic Tests

It is desirable to have some estimate of an individual's physical condition before initiating any exercise program. Physical condition or physical fitness may be defined in numerous ways, but for the purpose of this report, the definition used is "the capacity of the individual for prolonged heavy work." (1, p. 314)

Maximal oxygen uptake is probably the best measure of this type of fitness, but must be measured in a laboratory setting and requires a great deal of time per S. Therefore, alternate tests which are simple and inexpensive to administer yet still accurate and reliable are called for. Two such tests are Cooper's 12-Minute Test and 1.5-Mile Test. The correlation coefficient between the 12-minute test and laboratory measures of maximal oxygen uptake is reported as .90 (4).

The 12-minute test consists of having the subject walk and/or jog as great a distance as he can cover in the specified time. Tables 1 and 2 present the fitness categories for men and women by age group according to this test.

TABLE 1
12-Minute Test for Men^a

Fitness Category	Age			
	Under 30	30-39	40-49	50 and up
Very Poor	Under 1.0 mile	Under .5 mile	Under .85 mile	Under .80 mile
Poor	1.0-1.24	.95-1.14	.85-1.04	.80-.99
Fair	1.25-1.49	1.15-1.39	1.05-1.29	1.00-1.24
Good	1.50-1.74	1.40-1.64	1.30-1.54	1.25-1.49
Excellent	Over 1.74	Over 1.64	Over 1.54	Over 1.49

^aFrom Cooper, K. The new aerobics. New York: M. Evans Company, 1970. P. 30.

TABLE 2

12-Minute Test for Women^a

Fitness Category	Age			
	Under 30	30-39	40-49	50 and up
Very Poor	Under .95 mile	Under .85 mile	Under .75 mile	Under .65 mile
Poor	.95-1.14	.85-1.04	.75-.94	.65-.84
Fair	1.15-1.34	1.05-1.24	.95-1.14	.85-1.04
Good	1.35-1.64	1.25-1.54	1.15-1.44	1.05-1.34
Excellent	Over 1.64	Over 1.54	Over 1.44	Over 1.34

^aFrom Cooper, K. The new aerobics. New York: M. Evans Company, 1970. P. 30.

Similar results are obtained with the 1.5-mile test. For this situation, the Ss fitness level is determined by the time required to travel 1.5 miles, as shown in Table 3. A separate chart for women is not yet available because of insufficient data.

These norms were established for civilians running in lightweight clothes and tennis shoes over a flat course. The standards for the Army physical readiness training test for men are slightly lower, which would indicate the likelihood that running in fatigues and combat boots would result in a time approximately 30 seconds slower than in attire designed for the fastest possible time. Further research in this area is needed for a more precise comparison.

TABLE 3

1.5-Mile Test for Men^a

Fitness Category	Age			
	Under 30	30-39	40-49	50 and up
Very Poor	Over 16:31	Over 17:31	Over 18:31	Over 19:31
Poor	14:31-16:30	15:31-17:30	16:31-18:30	17:01-19:00
Fair	12:01-14:30	13:01-15:00	14:01-16:30	14:31-17:00
Good	10:16-12:00	11:01-13:00	11:31-14:00	12:01-14:30
Excellent ^b	Under 12:00	Under 11:01	Under 11:30	Under 12:00

^aFrom Cooper, K.H. The new aerobics. New York: M. Evans Company, 1970. P. 31.

^bFor military personnel, the excellent requirements are 15-30 seconds faster.

Power Tests

Sit-ups and push-ups are included as an indication of abdominal and upper shoulder girdle strength. It is obvious that these types of strengths are related to many tasks the individual soldier is called upon to perform regularly. Tables 4 and 5 present guidelines for evaluating sit-up and push-up scores according to sex and age group. The number given represents the minimum requirement for that category. These norms are based on a civilian population. Sit-ups are performed with the knees bent. Push-ups for women are performed with weight on the hands and knees and with the back kept straight.

TABLE 4
Guidelines for Number of Sit-Ups and
Push-Ups by Age Groups (Men)^a

Classifi- cation	15-25		Age Groups (Years) 26-35		Over 35	
	Sit-ups	Push-ups	Sit-ups	Push-ups	Sit-ups	Push-ups
Minimum	10	8	8	7	5	3
Fair	25	15	20	12	15	8
Good	50	25	40	20	30	15
Excellent	80	40	70	30	50	20

^aFrom Fox, E.L., & Mathews, D.K., Interval training: Conditioning for sports and general fitness. Philadelphia; W.B. Saunders Company, 1974, P. 241 (Men).

TABLE 5
Guidelines for Number of Sit-Ups and
Push-Ups by Age Groups (Women)^a

Classifi- cation	15-25		Age Groups (Years) 26-35		Over 35	
	Sit-ups	Push-ups	Sit-ups	Push-ups	Sit-ups	Push-ups
Minimum	6	8	4	7	2	3
Fair	15	15	10	12	5	8
Good	20	25	15	20	10	15
Excellent	30	40	20	30	15	20

^aFrom Fox, E.L., & Mathews, D.K., Interval training: Conditioning for sports and general fitness. Philadelphia: W.B. Saunders Company, 1974. P. 242 (Women).

By evaluating the results of the above three tests, one aerobic plus two power, the experimenter makes an approximate determination of the overall fitness level of the troops. This information is used to establish the initial intensity of the training program.

Energy System

If it is possible to have troops on a training schedule for more than 2 weeks, the major energy source for the activity to be tested is also determined. Training distances and rest intervals for the latter segment of the program are set up according to this assessment.

Without going into the complex chemical reactions involved in converting sugars or carbohydrates to usable energy, the three potential sources are the ATP-PC system, the lactic acid system (LA) and the aerobic system (O_2). Each system provides adenosintriphosphate, the prime energy substance, in differing ways and at varying speeds. Therefore, each system has to be developed in a specific way.

The simplest way of determining which system is the dominant one used for any activity is to analyze that activity according to time of involvement (Table 6). For example, the obstacle course at the U.S. Army Human Engineering Laboratory (HEL) requires more than 3 minutes to complete when in combat uniform/equipment ensemble (assault infantry 32-pound load) so the energy system being used is the aerobic one. On the other hand, if the task solely involved in the testing situation were scaling a wall, it would require a short explosive burst of energy and would depend on the ATP-PC system.

TABLE 6
Four Work Effort Areas with Performance Times
and Major Energy System(s) Involved

Area	Performance Time	Major Energy System(s) Involved
1	Less than 30 seconds	ATP-PC
2	30 seconds to 1-1/2 minutes	ATP PC and LA
3	1-1/2 minutes to 3 minutes	LA and O_2
4	Greater than 3 minutes	O_2

Revised from Fox, E.L., & Mathews, D.K., Interval training: Conditioning for sports and general fitness. Philadelphia: W.B. Saunders Co., 1974, P. 18.

TYPE OF TRAINING

The training program presented below is an Interval Training Program (ITP). This program alternates periods of work and rest rather than requiring continuous exertion. Intermittent work and rest allows the individual to accomplish a greater amount of work prior to the onset of fatigue than he could perform if he were working continuously.

Some basic guidelines are presented below:

1. Before and after any activity, some stretching exercises are performed to reduce possible muscle injury and stiffness.
2. Troops are instructed to start at a slow pace for the first few repetitions, then gradually to increase their speed.
3. Work intervals are of sufficient intensity to elevate the heart rate to at least 150 but no more than 180 beats per minute by the completion of a set of repetitions. This measure is taken the first 10 seconds after cessation of exercise.
4. Rest intervals vary according to the energy system being developed and the length and intensity of the work interval, thus, the rest interval between repetitions in a set ranges from less than one to three times the work interval. The rest interval between sets is sufficient to allow the heart rate to fall below 120 beats per minute (7) (6). Since the desired recovery requires at most a rest interval of three times the length of the work period (6), this recovery should occur within 5-10 minutes from cessation of activity. If only one or two Ss have an accelerated pulse after rest, they are eliminated from the next set. If more than that have an accelerated pulse, the rest interval is extended and the set load is reduced.
5. Ss are required to walk or move during rest times to further develop the aerobic system. Rest intervals are comprised of complete rest for the ATP-PC system.
6. For maximum results, a total of at least 1-1/2 miles of running is incorporated into the training period.

SPECIFIC TRAINING

When specific skills are a part of the testing situation, practice sessions are also included on each skill. This is to reduce the effect of learning in experiments with more than one trial. If the task is strenuous, it also provides specific conditioning for that task when repeated frequently within a short period of time.

EXAMPLE OF TRAINING PROGRAM FOR THE OBSTACLE COURSE

A sample 5-day program designed for troops in low average condition is presented below. It remains basically the same whether used for 1 day or 1 week. If a longer training period is possible, the overload is increased gradually by increasing the distances, decreasing the rest interval or increasing the total number of repetitions. A specific 5-day plan is presented first, followed by examples of alterations required for training programs of different lengths.

One preliminary day is necessary for the testing of troops to determine their initial condition. Since this is usually an all-out effort, it is preferable to test them on Friday and allow the weekend for rest before initiating training.

FIVE-DAY PLAN

First Day

10 minutes of stretching and warm-up calisthenics, include sit-ups and push-ups

Once through the obstacle course

Run easy 1/2 mile, rest 10-15 minutes, repeat twice

10 minutes of stretching, walking to cool down

Second Day

Morning:

10-15 minutes of stretching for warm-up

Divide into three groups, one runs while the other two rest

One set with three repetitions of 200 meters

One set with six repetitions of 100 meters

10 minutes of stretching for cool down

Afternoon:

Each individual does five repetitions of each obstacle in either Group A or Group B. They should work in groups of three to five; as soon as an obstacle has been passed by the group, they do it again.

Group A

Log Balance
Up and Down
Low Wall
Low Crawl
Down and Out
Zig Zag

Group B

High Fence
High Crawl
High Hurdles
Tube
High Wall
House

(These were initially divided in this manner to equalize the time involvement. Would probably be easier to do by rows on the course.)

Third Day

Morning:

Warm-up

One set with four repetitions of 200 meters

One set with six repetitions of 100 meters

Cool Down

Afternoon:

Alternate group of obstacles is practiced.

Fourth Day

Morning:

Warm-up

One set with three repetitions of 300 meters

One set with six repetitions of 100 meters

Cool down

Afternoon:

All obstacles are practiced.

Fifth Day

Morning:

Warm-up

One set with four repetitions of 300 meters

One set with six repetitions of 100 meters

Cool down

Afternoon:

Run obstacle course when troops are rested.

WITH LESS TIME

One Day (Divide into morning and afternoon if advisable.)

Warm-up

Run through course.

Practice five repetitions of each obstacle.

Run through course.

Two or Three Days

First day is same as in 5-day plan

Morning correspond to same day of 5-day plan

Afternoons:

Two days - practice each obstacle five times, run through course

Three days - practice each obstacle five times on the second and third days, run course on third day.

MORE THAN ONE WEEK

First Week - Same as 5-day plan.

Second Week - Divide into two groups to reduce length of rest interval. Gradually increase the training distance to 2,400 meters.

Warm-up

One set with six repetitions of 200 meters

One set with eight repetitions of 100 meters

Cool down

One set with five repetitions of 300 meters

One set with six repetitions of 100 meters

One set with two repetitions of 600 meters

Two sets with six repetitions of 100 meters

One set with two repetitions of 800 meters

Two sets with six repetitions of 50 meters

From this point on, distances can be alternated as desired for variety for the runner, but emphasis within a work-out remains centered around the 300- to 600-meter distances. The next step is to go back several days to an easier ITP and reduce the rest interval to one-half the time required for the work interval, or minimum times are set which are 2 to 5 seconds slower than the individual's best time for that distance.

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